WHAT IS CLAIMED IS:

1. An optical device, for manipulating incident light of at most a certain maximum wavelength, comprising:

(a) a substantially planar grating including a plurality of electrically conducting stripes and having a space-variant, continuous grating vector, at least a portion of said grating having a local period less than the maximum wavelength of the incident light.

2. The device of claim 1, wherein a magnitude of said grating vector varies laterally and continuously.

3. The device of claim 1, wherein a direction of said grating vector varies laterally and continuously.

4. The device of claim 1, wherein said grating vector is periodic.

5. The device of claim 4, wherein said grating is translationally periodic.

6. The device of claim 4, wherein said grating is rotationally periodic.

7. The device of claim 1, wherein said stripes include a metal.

8 The device of claim 1, further comprising:

(b) a substrate supporting said stripes.

9 The device of claim 8 wherein said substrate includes a material selected from the group consisting of gallium arsenide, zinc selenide, quartz and silica glass.

10. The device of claim 1, wherein said grating is operative to pass laterally uniform, polarized incident light with a predetermined, laterally varying transmissivity.

11. The device of claim 10, wherein said transmissivity varies periodically in one lateral dimension.

12. The device of claim 1, wherein said grating is operative to reflect laterally uniform, polarized incident light with a predetermined, laterally varying reflectivity.

13. The device of claim 12, wherein said reflectivity varies periodically in one lateral dimension.

14. The device of claim 1, wherein said grating is operative to transform light incident thereon into a transmitted beam having a predetermined, laterally varying polarization state.

15. The device of claim 14, wherein said transmitted beam has an azimuthal angle that varies linearly in one lateral dimension.

16. The device of claim 14, wherein said transmitted beam is radially polarized.

17. The device of claim 16, wherein said radial polarization is in-phase.

18. The device of claim 16, wherein said radial polarization is anti-phase.

19. The device of claim 14, wherein said transmitted beam is azimuthally polarized.

20. The device of claim 19, wherein said azimuthal polarization is in-phase.

21. The device of claim 19, wherein said azimuthal polarization is anti-phase.

22. The device of claim 1, wherein said grating is operative to transform light incident thereon into a reflected beam having a predetermined, laterally varying polarization state.

23. The device of claim 22, wherein said reflected beam has an azimuthal angle that varies linearly in one lateral dimension.

24. The device of claim 22, wherein said reflected beam is radially polarized.

25. The device of claim 24, wherein said radial polarization is in-phase.

26. The device of claim 24, wherein said radial polarization is anti-phase.

27. The device of claim 22, wherein said reflected beam is azimuthally polarized.

28. The device of claim 27, wherein said azimuthal polarization is in-phase.

29. The device of claim 27, wherein said azimuthal polarization is anti-phase.

30. A particle accelerator, comprising:

(a) a source of light;

(b) a first optical mechanism for forming said light into an annular beam;

(c) the device of claim 1, for imposing radial polarization on said annular beam;

(d) a second optical mechanism for focusing said radially polarized annular beam onto a focal region; and

(e) a particle source for directing a beam of the particles longitudinally through said focal region.

31. A method of cutting a workpiece, comprising the steps of:

(a) providing a beam of light;

(b) imposing radial polarization on said beam of light, using the device of claim 1, and

(c) directing said radially polarized beam at the workpiece to cut the workpiece.

32. An apparatus for measuring a polarization state of light, comprising:

(a) the device of claim 1; and

(b) a mechanism for measuring a lateral variation of an intensity of the light after the light has been manipulated by the device of claim 1.

33. A method of modulating an intensity of laterally uniform, polarized light of at most a certain maximum wavelength, comprising the steps of:

(a) solving an equation

$$\nabla \times \vec{K}(K_0, \beta) = 0$$

for a grating vector $\vec{K}$ that is defined by a wavenumber K_0 and by a direction β relative to a reference direction, the modulation depending on β, $\vec{K}$ being such that at least a portion of a grating fabricated in accordance with $\vec{K}$ has a local period less than the maximum wavelength of the light;

(b) fabricating said grating in accordance with said grating vector $\vec{K}$; and

(c) directing the light at said grating.

34. The method of claim 33, wherein said fabricating is effected by forming said grating as electrically conducting stripes on a substrate.

35. The method of claim 34, wherein said substrate includes a material selected from the group consisting of gallium arsenide, zinc selenide, quartz and silica glass.

36. A method of imposing a polarization state having a predetermined, laterally varying azimuthal angle ψ on light of at most a certain maximum wavelength, comprising the steps of:

(a) solving an equation

$$\nabla \times \vec{K}(K_0, \beta) = 0$$

for a grating vector $\vec{K}$ that is defined by a wavenumber K_0 and by a direction β relative to a reference direction, β being related to ψ by $\beta = \psi - \Delta\psi(K_0)$, $\vec{K}$ being such that at least a portion of a grating fabricated in accordance with $\vec{K}$ has a local period less than the maximum wavelength of the light;

(b) fabricating said grating in accordance with $\vec{K}$; and

(c) directing the light at said grating.

37. The method of claim 36, wherein said reference direction is an x-direction of a Cartesian (x,y) coordinate system, so that K_0 and β satisfy:

$$\frac{\partial K_0}{\partial y}\cos(\beta) - K_0 \sin(\beta)\left[\frac{\partial \psi}{\partial y} - \frac{\partial \Delta\psi}{\partial K_0}\frac{\partial K_0}{\partial y}\right] = \frac{\partial K_0}{\partial x}\sin(\beta) + K_0 \cos(\beta)\left[\frac{\partial \psi}{\partial x} - \frac{\partial \Delta\psi}{\partial K_0}\frac{\partial K_0}{\partial x}\right]$$

38. The method of claim 36, wherein said reference direction is a radial direction of a polar (r,θ) coordinate system.

39. The method of claim 38, wherein said fabricating is effected by forming said grating as electrically conducting stripes on a substrate.

40. The method of claim 39, wherein said substrate includes a material selected from the group consisting of gallium arsenide, zinc selenide, quartz and silica glass.

41. A method of measuring a polarization state of light of at most a certain maximum wavelength, comprising the steps of:

(a) providing a grating having a transmission axis that varies in one lateral dimension, at least a portion of said grating having a local period less than the maximum wavelength of the light;

(b) directing the light at said grating;

(c) measuring an intensity of the light that has traversed said grating; and

(d) determining three Stokes parameters of the light from said intensity.

42. The method of claim 41, wherein said Stokes parameters are S_0, S_1 and S_2.

43. The method of claim 41, further comprising the step of:

(e) causing at least a portion of the light to traverse a quarter wave plate before traversing said grating.

44. The method of claim 43, wherein said Stokes parameters are S_0, S_1 and S_3.

45. The method of claim 41, wherein said measurement is a near-field measurement.

46. The method of claim 41, wherein said transmission axis varies continuously in said one lateral dimension.

47. The method of claim 46, wherein said transmission axis varies linearly in said one lateral dimension.

48. The method of claim 41, wherein said grating is substantially planar and includes a plurality of electrically conducting stripes arranged so that said grating has a space-variant, continuous grating vector, said transmission axis being a direction of said grating vector.

49. The method of claim 41 wherein said Stokes parameters are determined by performing respective integral transforms of said intensity in said lateral dimension.

50. A method of measuring a polarization state of light of at most a certain maximum wavelength, comprising the steps of:

(a) providing a grating having a reflection axis that varies in one lateral dimension, at least a portion of said grating having a local period less than the maximum wavelength of the light;

(b) directing the light at said grating;

(c) measuring an intensity of the light that is reflected from said grating; and

(d) determining three Stokes parameters of the light from said intensity.

51. An optical device, for transforming an incident beam of light into a transformed beam of light, comprising:

(a) a substantially planar grating including a plurality of metal stripes and having a space-variant continuous grating vector, such that the transformed beam is substantially free of propagating orders higher than zero order.

52. The device of claim 51, wherein a magnitude of said grating vector varies laterally and continuously.

53. The device of claim 51, wherein a direction of said grating vector varies laterally and continuously.

54. The device of claim 51, wherein said grating vector is periodic.

55. The device of claim 51, wherein said stripes include a metal.

56 The device of claim 51, further comprising:

(b) a substrate supporting said stripes.

57. The device of claim 51, wherein the transformed beam is a transmitted beam, and wherein said grating is operative to pass laterally uniform, polarized incident light with a predetermined, laterally varying transmissivity.

58. The device of claim 51, wherein the transformed beam is a reflected beam, and wherein said grating is operative to reflect laterally uniform, polarized incident light with a predetermined, laterally varying reflectivity.

59. The device of claim 51, wherein the transformed beam is a transmitted beam having a predetermined, laterally varying polarization state.

60. The device of claim 1, wherein the transformed beam is a reflected beam having a predetermined, laterally varying polarization state.

61. A particle accelerator, comprising:

(a) a source of light;

(b) a first optical mechanism for forming said light into an annular beam;

(c) the device of claim 51, for imposing radial polarization on said annular beam;

(d) a second optical mechanism for focusing said radially polarized annular beam onto a focal region; and

(e) a particle source for directing a beam of the particles longitudinally through said focal region.

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62. A method of cutting a workpiece, comprising the steps of:

(a) providing a beam of light;

(b) imposing radial polarization on said beam of light, using the device of claim 51, and

(c) directing said radially polarized beam at the workpiece to cut the workpiece.

63. An apparatus for measuring a polarization state of light, comprising:

(a) the device of claim 51; and

(b) a mechanism for measuring a lateral variation of an intensity of the light after the light has been manipulated by the device of claim 1.

64. A method of transforming an incident beam of laterally uniform, polarized light into a transformed beam having a modulated intensity, comprising the steps of:

(a) solving an equation

$$\nabla \times \vec{K}(K_0, \beta) = 0$$

for a grating vector $\vec{K}$ that is defined by a wavenumber K_0 and by a direction β relative to a reference direction, the modulation depending on β, $\vec{K}$ being such that the transformed beam is substantially free of propagating orders higher than zero order;

(b) fabricating said grating in accordance with said grating vector $\vec{K}$; and

(c) directing the incident beam at said grating.

65. A method of transforming an incident light beam into a transformed beam upon which is imposed a polarization state having a predetermined, laterally varying azimuthal angle ψ, comprising the steps of:

(a) solving an equation

$$\nabla \times \vec{K}(K_0, \beta) = 0$$

for a grating vector $\vec{K}$ that is defined by a wavenumber K_0 and by a direction β relative to a reference direction, β being related to ψ by $\beta = \psi - \Delta\psi(K_0)$, $\vec{K}$ being such that the transformed beam is substantially free of propagating orders higher than zero order;

(b) fabricating said grating in accordance with $\vec{K}$; and

(c) directing the incident beam at said grating.

66. A method of measuring a polarization state of an incident light beam, comprising the steps of:

(a) providing a grating having a transmission axis that varies in one lateral dimension, said grating being operative to transform the incident beam into a transformed beam that is substantially free of propagating orders higher than zero order;

(b) directing the incident beam at said grating;

(c) measuring an intensity of the transformed beam; and

(d) determining three Stokes parameters of the light from said intensity.